POLICY SYNTHESIS

for USAID - Bureau for Africa
Office of Sustainable Development

Number 28 February 1997

IMPACT ASSESSMENT OF AFRICAN AGRICULTURAL TECHNOLOGY DEVELOPMENT AND TRANSFER: Synthesis of Findings and Lessons Learned

By

P. Anandajayasekeram, William A. Masters, and James F. Oehmke

Food Security II Cooperative Agreement between U.S. Agency for International Development, Global Bureau, Economic Growth Center, Office of Agriculture and Food Security and Department of Agricultural Economics, Michigan State University

BACKGROUND: Since 1992, a series of studies identifying and quantifying the impacts of technology development and transfer (TDT) for agricultural and natural resources in sub-Saharan Africa has been funded by AID and other donors. These studies have played a crucial role in reversing the conventional wisdom of the 1980s and early 1990s, namely that TDT hadn't generated impact. In fact, African agricultural TDT has contributed to substantial improvements in the welfare of African producers and consumers. Moreover, the studies have helped to delineate the role that agricultural TDT can play in helping to address the very serious challenges that confront Africa and Africans today.

This document synthesizes the current state of knowledge about the impacts of African agricultural TDT. It is based on results presented at the Roundtable Discussion on Impact Assessment of African Agricultural Technology Development and Transfer, held in Washington D.C., Jan. 9-10, 1997.

IMPACT ASSESSMENTS RESULTS:
Evidence: Although countries' individual experiences are complex and uneven, examination of African aggregate data shows evidence of significant deterioration between 1971 and 1984, followed by a modest recovery over the past 12 years. The FAO index of total agricultural production fell consistently from 1971 to 1984, for a cumulative decline of 22%. Coupled with rapid population growth, this led a decline of 40% in agricultural exports and a tripling of imports. From 1984 to 1995 there is a sustained improvement in yields in East, West and Southern Africa. In the Sahel, cereal grain production doubled between 1984 and 1995. For all of sub-Saharan Africa, agricultural production has kept pace with population growth over the last 12 years.

A number of factors--policy reform, improved rainfall in some regions, reduced population growth in some areas, and relative political stability, among others--have contributed to the shift from a declining agricultural to one of modest growth. The aggregate evidence on Africa's success in increasing average cereal yields also points to an unrecognized story of successful TDT, as farmers adopt increasingly productive varieties and production techniques.

Evidence from case studies is summarized by the rate of return (ROR) on investment in TDT. The ROR is the single most convenient and accurate number for summarizing the benefits, costs and time pattern of TDT activities. The benefits included are usually directly related to producer and consumer well-being. The ROR studies are categorized as *ex post*, those which quantify historical benefits and costs (Table 1; for earlier studies see Policy Synthesis No. 20), or *ex ante*, which project future benefits and costs (Table 2).

The evidence from the impact case studies indicates that agricultural and natural resource TDT activities have generated impact sufficient to justify the investments. Impacts have been generated across commodities and countries, in different agroclimatic settings. The evidence is sufficient to support continued funding of agricultural and natural resource TDT in Africa.

Methodological Issues: The ROR may well be the best single-number summary available of TDT impact, but it is still only a single indicator. This leads to three methodological issues that impact assessments should address. First, the current trend of expanding the range of benefits quantified, for example by including environmental benefits (and costs), is appropriate and should be continued. Second, the comprehensiveness of benefits included needs to be more clearly communicated to policy makers. For example, the standard calculation of consumer benefits implicitly includes better nutrition, even if this benefit is not measured explicitly and hidden in the economic calculations. Third, efforts to understand the attribution of benefits among TDT and complementary investments should be continued. The purpose of these efforts is not to define which activity should get a bigger share of the budget, but to design a portfolio of complementary investments that generates the greatest possible impact. Similarly, impact assessments that investigate constraints to generating impact may help target funds toward those areas that have the greatest potential payoffs.

Thematic and Programmatic Issues: The impact case studies identify several issues that will have significant affects on the future impacts of TDT:

- Improving the enabling environment for TDT.
- Defining a research agenda for resource-poor (rainfall, soil quality) areas.
- Defining an agenda for remote and poor-access areas.
- Allocating effort between smallholders and large commercial farmers.
- Improving institutional structures and terms of service.
- Allocating funds to TDT activities with high potential payoffs.
- Sub-national, national and regional collaboration.
- Improving linkages with clients, stakeholders and the private sector.
- TDT is a lengthy process that requires continuity in funding and direction.

To give one example, the ROR evidence indicates that breeding activities in low rainfall areas have generated modest RORs; innovative natural resource management techniques may have higher payoffs, and may improve the impact of breeding.

THE FUTURE OF IMPACT ASSESSMENT: Impact assessment studies serve several purposes. They can (and have) help to generate additional funds; they provide information that is used and is useful in determining TDT priorities; they provide recognition to and by scientists of social welfare improvements; and they help policy makers to think about the real benefits of agriculture and agricultural TDT. For these reasons, impact assessment is being, and should continue to be, institutionalized in national and regional research organizations. Future impact assessments can improve by better communicating results, providing information on critical areas of needed TDT, and by defining those characteristics of the enabling environments that will help scientists to generate the greatest improvements in social well-being.

*Partial funding for this research was provided by the Technology Development and Transfer Unit of the Productive Sector Growth and Environment Division, Office of Sustainable Development, Bureau for Africa, USAID (AFR/SD/PSGE/TDT). The synthesis was prepared under the Food Security II Cooperative Agreement Between AID/Global Bureau, Office of Agriculture and Food Security, and the Department of Agricultural Economics at Michigan State University. The views expressed in this document are exclusively those of the authors.

Anandajayasekeram is Economic Impact Advisor, SACCAR; Masters is assistant professor, Purdue Uniersity; and Oehmke is associate professor, MSU.

Table 1. Summary of Recent Impact Assessments of African Agricultural Technology with *Ex-Post* Rates of Return.

AUTHOR(S) AND DATE OF STUDY	COMMODITY, LOCATION AND YEARS COVERED	ROR (%)	ANNOTATIONS
Ewell, 1992	East Africa, potato, 1978-1991	91%	Regional network/NARS collaboration.
Sanders, 1994	Ghana, maize, 1968-1992	74%	New cultivars with additional inorganic fertilizer.
	Cameroon, sorghum, 1980-1992	2%	One new cultivar (S-35).
Smale and Heisey, 1994	Malawi, maize, 1957-1992	4-7%	Improved research performance since 1985.
Kupfuma, 1994	Zimbabwe, maize, 1932-1940	43.5%	Research and extension activities of the Department of Research and Specialist Services.
Khatri, Thirtle and van Zyl, 1995	South Africa, aggregate agriculture	44%	Econometric decomposition of agricultural productivity growth.
Ahmed, Masters and Sanders, 1995	Sudan, sorghum, 1979-1992	53-97%	New cultivar (HD-1) introduced in irrigation scheme, with additional inorganic fertilizer and erosion control.
Seck, Sidibé, and Béye, 1995	Senegal, cotton, 1985-1993	34-37%	New cultivars; moderate to high levels of inorganic fertilizers were already in use.
Ouedraogo, Illy and Lompo, 1996	Burkina Faso, maize, 1982-1993	78%	Varietal improvement.
Ouedraogo and Illy, 1996	Burkina Faso, stone dikes, 1988-1994	7%	Natural resource management/soil and water conservation technique.
Seidi, 1996	Guinea Bissau, rice, 1980-1994	26%	New cultivars for mangrove-swamp areas.
Makanda and Oehmke, 1996	Kenya, wheat, 1921-1990	0-12%	Based on econometric estimation of research impact on average yield.
Akgnungor *et al*., 1996	Kenya, wheat, 1921-1990	14-30%	Time-series econometric methods. National data show more rapid yield growth following independence.

Table 2. Summary of Impact Studies of African Agricultural Technology with *Ex-Ante* ROR or Benefit-Cost Ratio Results

AUTHOR(S) AND DATE OF STUDY	LOCATION, YEARS COVERED, AND TECHNIQUE OR COMMODITY	ROR or B-C RATIO	ANNOTATIONS
Norgaard, 1988	Africa, 1977-2003, cassava	149:1	Benefit: Cost ratio, attributes much of the value of cassava production to mealybug control.
Schwartz *et al*., 1989	Senegal, 1981-2005, cowpea	63%	TDT impacts consist of improved household food security and scientist training.
MacMillan *et al*., 1991	Zimbabwe, 1991-1996, maize	1.35:1	Benefit-cost ratio for outreach and demonstration of improved varieties for smallholders. Implied ROR of 22%.
Laker-Ojok, 1994	Uganda, 1985-2996: maize Sunflower soybean	27-58% 10-66% <0-20%	
Sterns and Bernsten, 1994	Cameroon, 1979-98: cowpea sorghum	15% 1%	Cowpea TDT introduced a new farming systems; sorghum TDT added a drought-escape variety useful about one year in three.
Mazzucato and Ly, 1994	Niger, 1975-2011, combined millet, sorghum and cowpea	2-10%	Low RORs attributable to few varietal releases (3 millet and 1 cowpea) and low adoption of released varieties.
Bertelsen and Ouédraoga, undated	Burkina Faso, 1990-2003, zaï	53%	Zaï is an indigenous knowledge technique of incorporating organic fertilizer in sorghum and millet planting holes before introducing the seed.
Fisher, Fall and Sidibé, 1995	Senegal, 1995-2004, rice	66-83%	New cultivars and inorganic fertilizer.
Tre, 1995	Sierra Leone, 1976-2010, rice	18-21%	New cultivars for mangrove swamps.
Anandajayasekeram *et al*., 1996	Zimbabwe, 1980-99, sorghum Namibia, 1988-99, millet	22% 11%	New cultivar (SV-2). New cultivar (Okashana 1).
Kuyvenhoven, Becht and Ruben, 1996	Mali, rock phosphate	43-271%	Assumes 50% of production value due to phosphate.
Aghib and Lownberg-DeBoer, undated	Ten countries, 1985-2009, sorghum	58%	Evaluates 8 INTSORMIL striga-resistant varieties in ten countries. Includes WVI extension and their costs.